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Canada

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1. New Ways of Monitoring Canadian Crops : Sentinel-1

Sustainable food production remains a pressing challenge, and consequently scientists have been assessing the potential of the future Sentinel-1 Earth Observation (EO) mission to deliver new methods of monitoring crops grown around the world from space. Sentinel-1 is expected to be launched in 2013. Through the Canadian Space Agency (CSA) Government Related Initiatives Program (GRIP), Agriculture and Agri-Food Canada (AAFC) has developed new methods which use RADARSAT-1 and RADARSAT-2 for crop monitoring. Thanks to the expertise developed under GRIP, AAFC participated in a major international crop monitoring activity with the European Space Agency (ESA) to prepare for Sentinel-1. For the 2009 growing season, RADARSAT-2 data were acquired over Indian Head, Saskatchewan (Canada), Barrax (Spain) and Flevoland (The Netherlands), representing three important and diverse cropping systems. Sentinel-1 data were simulated from the RADARSAT-2 images. Results are indicating that C-Band sensors like Sentinel-1 and RADARSAT-2 are capable of providing accurate crop maps and of estimating indicators of crop growth, such as Leaf Area Index. This campaign, particularly as results are demonstrated over multiple international sites, supports the use of spaceborne radar data for operationally monitoring of crop acreage and productivity. To view simulated Sentinel-1 images of Indian Head (Saskatchewan, Canada) derived from RADARSAT-2, please visit: www.esa.int/images/IndianHead_H.jpg, www.esa.int/images/RadarImageIndianHead.jpg.

2. Agriculture: GEO Joint Experiment for Crop Area Monitoring

The Joint Experiment for Crop Area Monitoring (JECAM) is an initiative created by the GEO Agriculture Monitoring Community of Practice with the intent to enhance international collaboration around agricultural monitoring towards the development of a "systems of systems" to address issues associated with food security and a sustainable and profitable agricultural sector worldwide. The goal of the JECAM experiments is to facilitate the inter-comparison of monitoring and modelling methods, product accuracy assessments, data fusion, and product integration for agricultural monitoring. These international shared experiments are being undertaken at a series of sites which represent the world's main cropping systems and agricultural practices. The approach is to collect and share time-series datasets from a variety of Earth Observing (EO) satellites useful for agricultural monitoring, as well as in-situ crop and meteorological measurements for each site. In order for JECAM to succeed, collaboration with space agencies and commercial satellite data providers is needed to ensure access to and sharing of EO data of the test sites around the world. A meeting of CEOS member space agencies and interested commercial data providers will shortly be held in Ottawa with the intention to develop a documented, coordinated plan to acquire remotely-sensed data in support of the JECAM initiative. For more information, please visit umanitoba.ca/outreach/aesb-jecam/ and contact yves.crevier@asc-csa.gc.ca or Ian.Jarvis@agr.gc.ca.

3. Risk Management: Tracking Soil Moistures Extremes in Agricultural Regions of Canada with Earth Observation

The Growing Forward agricultural policy framework is a commitment to Canada's agriculture

sector that's focused on achieving results. One of its three objectives is to being proactive in managing risks. Soil moisture is a critical variable for agricultural production, with wet or dry extremes imposing a risk to seeding, crop growth and harvest activities. Through the Canadian Space Agency (CSA) Government Related Initiatives Program (GRIP), Agriculture and Agri-Food Canada (AAFC) is developing methods and data sets to monitor soil moisture conditions in Canada at various scales using active and passive microwave data sets. Using the AMSR-E C- and X- band passive microwave sensor, a soil moisture anomaly dataset has been developed that tracks weekly soil moisture extremes in the agricultural regions of Canada from 2002 to the present. This system of anomaly estimation based on Earth Observation (EO) data is currently being adapted to incorporate L-Band data from the Soil Moisture and Ocean Salinity (SMOS) EO mission. Through collaboration with NASA and CSA, AAFC is also working on preparing this monitoring prototype for data from the Soil Moisture Active Passive (SMAP) EO mission. Ongoing research within AAFC will link estimation of passive microwave surface soil moisture anomalies to field scale estimates of soil moisture from SAR sensors, including Radarsat-2. To view an example of surface wetness anomaly over the Prairies made with AMSR-E, please visit: www.asc-csa.gc.ca/eng/programs/grip/archive_110609.asp. For more information, please contact: catherine.champagne@AGR.GC.CA and guy.aube@asc-csa.gc.ca.

4. Adapting Cropping Systems to Climate Variations: Deriving Above Ground Biomass from Earth Observation

Achieving security of the food system, promoting health of the environment and providing innovation for growth of the agricultural sector are part of Agriculture and Agri-Food Canada (AAFC) strategic outcome. Change in crop biomass provides key information in agriculture for estimating the influence of climate variations on crop production. Although crop biomass is related to leaf area index early in the growing season, it cannot be monitored over the entire growing season without using mathematical models. Most of the crop growth and environmental models require input information on climate, soil, crop cultivars and management practices. AAFC is developing climate and soil spatial databases that can serve for model inputs. Projects are on-going to provide crop identification, leaf area index, crop fraction and a few management practices, such as tillage and crop residue management using Earth Observation (EO). However, key management practices for crop growth such as seeding dates are usually not available on a field basis for a given region, but can be accounted for using assimilation of EO data. After calibration into crop models of generic cultivars adapted to the regions of interest, assimilation of multi-temporal remote sensing data was proven essential for improving spatial prediction of crop biomass while accounting for the impacts of climate variability. Through the Canadian Space Agency (CSA) Government Related Initiatives Program (GRIP), AAFC is using RADARSAT-2 and other EO satellites for the (1) development of EO assimilation techniques into models, providing better estimates of biomass/yields to support numerous clients such as the commodity future communities and crop insurance; (2) assessment of impacts and adaptations to climate variations by tracking of crop yields and water consumption over the long term; (3) monitoring of crops used in bioenergy production. For more information, please contact and guy.aube@asc-csa.gc.ca.

5. Improving Environmental Predictions with SMOS and SMAP

In order to improve the representation of soil moisture (as well as surface temperatures and snow) in its environmental prediction systems, Environment Canada (EC) has completed the development of a first version of its Canadian Land Data Assimilation System (CaLDAS). This new system is currently being tested for operational implementation at the Canadian Meteorological Centre (CMC) and is expected to significantly improve important aspects of numerical weather prediction (low-level air temperature and humidity, atmospheric boundary layer, as well as clouds and precipitation). The impact resulting from the assimilation of observations from the Soil Moisture and Ocean Salinity (SMOS) mission is currently being investigated with CaLDAS. Results using synthetically-generated SMOS observations indicate substantial decreases of errors for near-surface as well as root-zone soil moisture. Assimilation of real SMOS data is expected to be performed in the coming months. These tests are relevant to the preparation for the assimilation of data from NASA's Soil Moisture Active and Passive (SMAP) mission, which will include higher-resolution radar observations. A plan for a Canadian participation to SMAP has been developed by EC in collaboration with CSA, and involves the participation of several partners, from universities and government departments. For more information, please contact stephane.belair@ec.gc.ca and paul.briand@asc-csa.gc.ca. For more information on CSA

SMOS related activities, please visit: www.asc-csa.gc.ca/eng/programs/grip/archive_091130.asp.

6. The SMOS Earth Observation Water Mission Keeps Tabs On Dry Spring Soils

Western Europe's exceptionally dry spring is clear to see in maps generated using data from SMOS. While these maps offer an interesting view of the stark difference in soil moisture compared to a year ago, the data are also important for agricultural and hydrological applications. The drought is causing serious problems for farmers and those managing water resources. In addition, dry earth and vegetation is posing a risk of forest fire. For more information about SMOS and dry spring soils, please visit: www.esa.int/esaEO/SEM7NKJSDNG_index_0.html.

7. RADARSAT Constellation Mission

The next generation of C-Band spaceborne SAR systems, the RADARSAT Constellation Mission (RCM), is currently in its detailed design phase, which was initiated in March 2010 following a successful preliminary design review. In order to achieve the key mission objectives, which are to increase the frequency of image revisits and the reliability of information so as to better address the needs of users in the areas of maritime surveillance, environment and ecosystem monitoring, and disaster management, the project is supported by a dedicated team from the Canadian Space Agency and several departments within the federal government, including the Users & Science Team (U&ST). This forum provides a mechanism for consulting with Government users of SAR data and data products and provides advice to the RCM management team. A senior scientist is also appointed by the members of the U&ST to act as the Lead Scientist to support science and applications development activities. Currently CSA is supporting government R&D efforts related to the capabilities of RCM. These include the application of compact polarimetry and rapid coherent change detection. In addition to representative from each department, the key members of the RCM Users & Science Team are: CSA Project Manager - Alain Carrier, CSA Mission Manager - Steve Iris; U&ST Co-Chairs - Terry Pultz (CCRS) and Paris Vachon (DRDC); Lead Scientist - Vern Singhroy.

8. Earth Observation Ecosystem Services Initiative : Update

The Earth Observation Ecosystem Services Initiative (EOESI) was introduced in the May 2011 issue of EO-Express (see article no. 2: www.asc-csa.gc.ca/eng/newsletters/eo_express/2011/0517.asp). A Challenge Paper was recently issued to stimulate discussion of EOESI. Feedback was solicited and it was impressive, both in volume (57 respondents) and in quality. This feedback was summarized in a Progress Report that was sent to interested stakeholders. A three-day workshop was held in Vancouver in May to discuss concepts and similar initiatives, reach common understanding, conduct preliminary design and plan the next steps. The workshop was very spirited and successful; workshop results are being documented and will be issued shortly on the EOESI web site. The initiative is driven by the Canadian Space Agency Earth Observation Applications and Utilizations (EOAU) Division and Environment Canada. For more information, please visit www.eoesi.com and contact yves.crevier@asc-csa.gc.ca.

9. Richelieu River Flood : CSA-NASA Partnership in Earth Observation Applications

Within the framework of the International Committee on Satellite Earth Observation (CEOS), the Canadian Space Agency (CSA) is collaborating with NASA on various projects to prevent, manage and respond to natural disasters. This partnership offers the opportunity for CSA and NASA to share Earth Observation (EO) data acquired by several Canadian and American satellites for scientific and operational purposes. These including the development of models, systems and procedures geared toward flood forecasting and response. During the flood event along the Richelieu areas (Quebec, Canada) in May 2011, CSA asked colleagues from NASA to acquire satellite images with the EO-1/ALI sensor (Earth Observation-1/Advanced Land Imager) in order to capture the flood in its entirety. These images complement RADARSAT-2 images acquired by the Canadian Government over the past weeks over the affected region, providing additional detail thanks to the multi-spectral and pan-chromatic imaging capabilities of ALI. In combination with RADARSAT-2 images

acquired at the peak of the flood, NASA's ALI images will give the opportunity to monitor the spatial extent of the flooded areas and assist authorities on the ground with their flood response measures. To view the animation of ALI and RADARSAT-2 data produced by the CSA Earth Observation Applications and Utilization (EOAU) division showing the recent flood situation along the Richelieu River, please visit: www.asc-csa.gc.ca/eng/programs/grip/archive_110520.asp. For more information, please contact guy.aube@asc-csa.gc.ca, guy.seguin@asc-csa.gc.ca or stuart.frye@nasa.gov.

10. Richelieu River Flood: Flood Extent RADARSAT-2 Product

During the Richelieu River flood, flood extent information has been derived from RADARSAT-2 images with a system developed and operated by Natural Resources Canada (NRCAN). NRCan worked closely with Public Safety Canada (PSC) (Ottawa and the Regional offices) and the Government Operations Centre (GOC) for the coordination of the satellite acquisition planning. This increased collaboration will assist federal coordination efforts and the post situation analysis. To view an exemple of the flood extent RADARSAT-2 product for the Saint-Paul-de-l'Île-aux-Noix area, please visit: www.asc-csa.gc.ca/eng/satellites/radarsat2/featured_image.asp. For more information, please contact: Don.Raymond@NRCan.gc.ca.

11. Ensuring The Safety of Canadians: Responding to the Red River Flood with RADARSAT

The 2011 Red River flood took place along the Red River of the North in Manitoba in Canada and North Dakota and Minnesota in the United States beginning in April 2011. The flood was, in part, due to high moisture levels in the soil from the previous year which meant that further accumulation would threaten the flood prone region. Though flood levels were below that of 2009 on the Red River, the 2011 Assiniboine River Flood was a 1 in 300 year flood. To view a flood product derived from RADARSAT-1 and RADARSAT-2 and used by Public Safety Canada to better manage the event, please visit: www.publicsafety.gc.ca/dir/_fl/2011-05-04-fld-sk-bil.pdf.

12. International Assistance: the United States Benefits From Canadian Earth Observation Technology During the Mississippi Flood

The Mississippi River floods in April and May 2011 were among the largest and most damaging recorded along the U.S. waterway in the past century, comparable in extent to the major floods of 1927 and 1993. In April 2011, two major storm systems deposited record levels of rainfall on the Mississippi River watershed. Rising from springtime snowmelt, the river and many of its tributaries began to swell to record levels by the beginning of May. Areas along the Mississippi itself experiencing flooding include Illinois, Missouri, Kentucky, Tennessee, Arkansas, Mississippi, and Louisiana. U.S. President Barack Obama declared the western counties of Kentucky, Tennessee, and Mississippi federal disaster areas. For the first time in 37 years, the Morganza Spillway has been opened, deliberately flooding 4,600 square miles (12,000 km2) of rural Louisiana to save most of Baton Rouge and New Orleans. To view RADARSAT-1 (May 30, 2010) and RADARSAT-2 (April 30 and May 3 2011) images of the flood, please visit: gs.mdacorporation.com/includes/images/NewsReleases/2011/20110503_Mississippi_flooding_export01_3dates.jpg.

13. Monitoring and Reporting on Forest Fire Activity at the National Scale: Canadian Wildland Fire Information System

The challenge of managing fire is to find ways to effectively balance the positive ecological aspects of fire with the negative social and economic impacts. The Government of Canada (GoC), through Natural Resources Canada's Canadian Forest Service (CFS), makes an important contribution to fire management in two ways. The CFS has maintained an internationally recognized research program since the mid-1920s that has resulted in many innovations and new operational tools. Over the past two decades, the GoC has also developed information systems that use advanced technologies, such as Earth Observation (EO) data, to monitor and report on forest fire activity at a national scale. The GoC is required, under international agreements such as the United Nations Framework Convention on Climate Change (UNFCCC), to report on carbon emissions from our forests. Recently, multiple NRCAN fire management initiatives have been supported through the Canadian Space Agency (CSA) Government Related Initiatives Program (GRIP). For example, the Fire

Monitoring, Accounting and Reporting System (FireMARS) was developed under GRIP. It is a computer-based system that relies heavily on EO data combined with spatial fire data from the Canadian Wildland Fire Information System (CWFIS) to estimate the annual carbon emissions from Canadian forest fires. To view hotspot data from EO satellites and the daily fire weather and fire behavior maps for the fire season, please visit: cwfis.cfs.nrcan.gc.ca/en_CA/index.

14. Alberta Wild Fires Monitored With Earth Observation Satellites

Several large wildfires raged in northern Alberta, Canada, in May 2011. The fires forced some energy and transportation companies to suspend operations. Multiple petroleum companies suspended drilling in the region and moved their employees to safety. Tan and gray smoke spanned hundreds of kilometers across Alberta, Saskatchewan, and Northwest Territories, Canada. The Alberta government reported 116 fires burning in the province, 34 of which were out of control. To view satellites images of the disasters areas taken by Moderate Resolution Imaging Spectroradiometer (MODIS) on Aqua on May 15 and 16, please visit: www.asc-csa.gc.ca/eng/programs/grip/archive_110524.asp. Fire detections are outlined in red. Strong winds fanned the fires on May 15 and 16, pulling thick plumes of smoke north.

15. Improving the Characterization of Fires with Earth Observation: NIRST

Federal, provincial, and territorial governments are developing new ways of understanding and characterizing wild land fires in Canada. A new Earth Observation (EO) instrument, called NIRST (New InfraRed Sensor Technology), was developed through the Canadian Space Agency (CSA) Space Technology Development Program. It is a narrow-swath infrared imager that will detect forest fires and other thermal events on land and will also measure sea surface temperatures over selected targets to support Aquarius instrument corrections. NIRST will measure forest fires with enough accuracy and resolution to determine characteristics of the fires, such as temperature and released energy. Measurement of fire radiative power (FRP) at a spatial resolution of 350 m should significantly improve estimates of carbon, aerosols and residual gases that are released into the atmosphere from biomass fires in Canada and globally. NIRST was achieved through the collaboration of CSA, Institute National d'Optique (INO, a Canadian industrial space company), the Argentine Space Agency (CONAE, Comisión Nacional de Actividades Espaciales) and NASA. NIRST will be placed on-board of the SAC-D/Aquarius satellite. In an ongoing collaboration with CONAE and an international team of scientists, the Canadian Forest Service of Natural Resources Canada will lead the development, validation and optimization of algorithms to support an Active Fire Product for Canadian forests from radiance measurements by NIRST. For more information, please visit: www.asc-csa.gc.ca/eng/media/backgrounders/2011/0610.asp.

16. Canadian Ocean Observing System Inventory

Canada's ocean estate covers a surface area of approximately 7.1 million square kilometres. This represents an area equivalent to about 70 percent of Canada's land mass. Information about Canada's oceans and Canadians' shared commitment to sustainable development and protection of our oceans to ensure healthy and productive aquatic ecosystems for the benefit of current and future generations. In 2010, a survey of the Canadian Ocean Observing Systems (OOS) and Observing System (OS) community was carried out by Fisheries and Oceans Canada (DFO) and the Oceans Science and Technology Partnership (OSTP) in close partnership with the Canadian Space Agency (CSA) Government Related Initiatives Program (GRIP). The objective was to produce a comprehensive inventory of existing OS in Canada that gives a clear knowledge of the targeted activities, including Earth Observation, and will help building a national strategy. The survey contacted over 400 organizations and individuals and identified over 65 OOS activities and characterized their users, operations and maturity levels. The results of the inventory are now available in a report that also includes recommendations on future activities to foster the development of OS industry. A preliminary analysis of OS socio-economic impacts has also been conducted. Reports can be consulted at www.qc.dfo-mpo.gc.ca/publications/index-eng.asp and www.ostp-psto.ca/Reports.asp. For more information, please contact: Ariane.Plourde@dfo-mpo.gc.ca and Guy.Aube@asc-csa.gc.ca.

17. Coastal Security Applications: Hazardous Ice Conditions in the Canadian Arctic Derived From RADARSAT-2

The Canadian Ice Service (CIS) provides accurate information about ice in Canada's waters and lands. It contributes to the safety of Canadians, to their property and to their environment by providing information on hazardous ice conditions in Canadian territorial waters. CIS provides present and future generations of Canadians with sufficient knowledge about their ice environment to support sound environmental policies. To view Peterman Glacier fragments along the Labrador Coast on May 6th 2011 with RADARSAT-2, please visit: www.ec.gc.ca/glaces-ice/default.asp?Lang=En&n=0417829C-1&wsdoc=ACBA19C6-47C8-495D-9C71-3290CD6BBDFD.

18. Canadian to Lead World Meteorological Organization

A Canadian was elected President of the World Meteorological Organization (WMO) on May 25th during the Sixteenth World Meteorological Congress being held in Geneva. David Grimes, the head of Environment Canada's Meteorological Service, was elected by representatives of the 189 member states and territories of WMO, a United Nations Specialized Agency. The president builds consensus among nations on our collective investments in Earth Observations (EO), research and services in an international enterprise that brings together national assets such as satellites, ships, high performance computers and, of course, people. The president's term is for four years. For more information, please visit: www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=21108326-AC72-4BAE-B850-37550EFD2AD5.

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